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Comparative Ability to Tolerate Heat Between Thai Indigenous Chickens, Thai Indigenous Chickens Crossbred and Broilers by Using Percentage of Lymphocyte

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Abstract: The purpose of this experiment was to compare the effects of high environmental temperatures on the percentage of lymphocytes between Thai Indigenous Chickens (TIC), Thai Indigenous Chickens Crossbred (TICC) and Broilers (BC) TIC and TICC and BC. One kilogram of male and female TIC and TICC and BC were maintained in the environmental temperature range of 26±2 and 38±2°C. Percentage of lymphocytes was investigated on days 1, 7, 14, 21 and 28 of an experimental period. The results revealed the following information: On days 1 and 28, the percentage of lymphocytes of male and female TIC, TICC and BC at 26±2 and 38±2°C was not significantly different ($p>0.05$). On days 7, 14 and 21 of the experimental period, the percentage of lymphocytes of the chickens at 26±2°C was significantly higher than that of chickens at 38±2°C ($p<0.05$). At 38±2°C, on day 7, the percentage of lymphocytes of the male and female TIC and TICC was significantly higher than the male BC ($p<0.05$). On day 14, the percentage of lymphocytes of the male TIC was significantly higher than the male BC ($p<0.05$) and on day 21 of the experimental period, the percentage of lymphocytes of the male and female TIC and TICC was significantly higher than that of the male BC ($p<0.05$). These phenomena indicated that the chickens maintained at high environmental temperatures, were under heat stress. Chickens adapted to high heat and the BC were less tolerant to the high heat than the TICC and TIC, respectively.

Key words: Heat stress, lymphocyte, Thai indigenous chickens, Thai indigenous chickens crossbred, broilers

INTRODUCTION

After birds are exposed to a high ambient temperature, their body temperature rises to higher than normal (Whittow, 2000). When the environmental temperature was over 32°C, it induced broilers to heat stress (Cooper and Washburn, 1998). Corticosteroid concentrations in blood have been used as a measure of environment heat stress in birds. In addition, the relationship between adrenocorticotropic hormone (ACTH) and leukocytes response has been widely examined (Altan *et al*., 2000). When birds were under heat stress, the percentage of lymphocyte decreased (Altan *et al*., 2000; Borges *et al*., 1999; Campo and Davilla, 2002; Borges *et al*., 2004). At present, percentage of lymphocytes is generally accepted as the indicator for heat stress in chickens.

Thai Indigenous Chickens (TIC), are the wild birds that have been domesticated in rural villages in Thailand over a long period of time. They are familiar with high environmental temperature. TIC, however, have a lower productive performance than broilers. To improve production, breeders have crossbred the TIC with chickens imported from overseas resulting in the Thai Indigenous Chicken Crossbreed (TICC), which is a crossbreed between ½ Thai indigenous chickens (cock) and ¼ Rhode Island Red and ¼ Plymouth Rock (hen). Knowledge about heat tolerance between TIC and TICC is limited. As such, the purpose of this experiment was to compare the effects of high environmental temperatures on the percentage of lymphocytes between TIC, TICC and Broilers (BC). Results from this preliminary study would provide fundamental knowledge for improving poultry production by identifying a heat tolerant genetic resource for poultry production in tropical regions.

MATERIALS AND METHODS

Twenty four TIC (12 males; 12 females), 24 TICC (12 males; 12 females) and 24 BC (12 males; 12 females), one kilograms of weight each and infectious disease-free, were obtained from a commercial farm near Mahasarakham University. The experiment was performed from April to July, 2005. The experiments were begun after a 7 day adaptation period. The chicks were fed a standard ration *ad libitum* with continuous light and water supplies. Relative humidity was 65%. The experimental design was a split-split-plot design in CRD. The main plot involved 2 temperature settings, i.e., 26±2°C (continuous temperature) and 38±2°C (cyclic temperature; 26±2°C, 38±2°C and 26±2°C; chickens were maintained at 38±2°C for 6 h/day). The sub plot was 2 x 3 factorial i.e., sex (male and female) and 3

Table 1: Percentage of lymphocyte of male and female Thai indigenous chickens, Thai indigenous chickens crossbred, broilers were maintained at 26±2 and 38±2°C on 1, 7, 14, 21 and 28 days of experimental period

		Environmental temperature at 26±2°C						Environmental temperature at 38±2°C						
		TIC		TICC		BC		TIC		TICC		BC		
Parameters	Days	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	SEM
Lymphocyte	1	75.00	72.83	77.00	74.00	73.17	73.33	76.67	73.17	73.67	74.84	78.17	78.83	2.40
(%)	7	74.17^{a}	72.0^{ab}	71.67^{ab}	73.00^{ab}	68.33^{ab}	70.17^{ab}	67.67^{ab}	57.83^{cd}	64.0^{bc}	58.50^{cd}	48.67^{e}	50.33^{de}	0.98
	14	76.0^{abc}	67.0^{cd}	65.50^{cd}	68.67^{bcd}	79.17^{ab}	83.00^{a}	75.0^{abc}	71.83^{bcd}	73.0^{abcd}	69.50^{bcd}	62.33^{d}	67.17^{cd}	0.89
	21	73.33^{ab}	73.00^{abc}	72.83^{abc}	73.17^{abc}	74.33^{abc}	70.67^{bcd}	79.33^{a}	78.00^{abc}	75.83^{abc}	75.00^{abc}	64.50^{d}	70.33^{cd}	0.89
	28	76.00	67.00	65.50	68.67	79.17	83.17	71.00	65.50	68.83	68.50	64.33	75.17	0.42

$^{a, b, c, d \text{ and } e}$within row, mean with no common superscript differ significantly ($p<0.05$). SEM = Standard Error of the Mean

breeds of chicken (TIC, TICC and BC). Six TIC, 6 TICC and 6 BC were maintained at each environmental temperature. On days 1, 7, 14, 21 and 28 of the experimental period, blood samples (via wing vein: 0.75 mL) were collected and transferred to tubes containing EDTA as an anticoagulant (Ritchie *et al*., 1994). Blood films were made, air dried then stained with Giemsa-Wright's stain. Differential white blood cell counts were performed using the standard avian guidelines of Ritchie *et al*. (1994). The percentage of lymphocytes was analyzed using the ANOVA procedure of Statistical Analysis System (1990). Means were separated by Duncan's multiple range tests. The level of significance was determined at $p<0.05$.

RESULTS AND DISCUSSION

The effects of high environmental temperature on the percentage of lymphocyte of the TIC, TICC and BC are shown in Table 1.

On day 7, the percentage of lymphocytes of the female TIC, TICC and male and female BC at 38±2°C was significantly lower than that of female TIC, TICC and male and female BC at 26±2°C ($p<0.05$). On days 14 and 21, the percentage of lymphocytes of the male BC at 38±2°C was significantly lower than that of male BC at 26±2°C ($p<0.05$). This was in accordance with the reports of Borges *et al*. (2004), Altan *et al*. (2000), Campo and Davila (2002) and Borges *et al*. (2004). Jain (1993) suggested that glucocorticoid, which marks released when chickens are under stress, causes lymphopenia and is attributed to lympholysis in blood, DNA damage, lymphoid tissue atrophy and increased shift of lymphocytes from blood to other body compartments, therefore, lymphocyte in blood circulation decreased (Compton *et al*., 1990; Heckert *et al*., 2002).

On day 1, the percentage of lymphocytes of the TIC, TICC and BC at 26±2 and 38±2°C was not significantly different ($p>0.05$). On days 7, 14 and 21 of the experimental period, the percentage of lymphocytes of the chickens at 26±2 and 38±2°C was significantly different ($p<0.05$). Furthermore, on day 28 of the experimental period the percentage of lymphocytes of TIC, TICC and BC at 26±2 and 38±2°C was not significantly different ($p>0.05$). These results were in accord with the report of Moberg and Mench (2000). They found that when animals were subjected to repeated stress, in the first few first days after exposure, they usually showed an increased response and then later the response decreased.

At 38±2°C, on day 7, the percentage of lymphocytes of the male and female TIC and TICC was significantly higher than the male BC ($p<0.05$). On day 14, the percentage of lymphocytes of the male TIC was significantly higher than that of the male BC ($p<0.05$) and on day 21 of experimental period the percentage of lymphocytes of the male and female TIC and TICC was significantly higher than the male BC ($p<0.05$). These phenomena showed that the BC was less tolerant to high heat than TIC and TICC.

Conclusion: Male and female TIC, TICC and BC were maintained at 26±2 and 38±2°C for 28 days. The percentage of lymphocytes of three breeds was determined on days 1, 7, 14, 21 and 28 of experimental period. The results of this study found that the percentage of lymphocytes of chickens maintained at thermoneutral was higher than that of chickens at high environmental temperature. Chickens adapted to high environmental temperature and finally, TIC and TICC tolerated high heat better than BC.

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